3. Charged cylinder ***(8 points)***

Dielectric cylinder of radius r carries a charge of surface density σ on its cylindrical surface and rotates with angular velocity ω.

i) (3 pts) Determine the magnetic induction B inside the cylinder. *Remark:* if you wish, you can use the expression for the inductance $L = \mu_0 N^2 S/l$ of a solenoidal coil of radius r, length $l \gg r$, area of cross-section S and number of loops N.

ii) (3 pts) A radial conducting wire connects the axis of the cylinder with the cylindrical surface (it rotates together with the cylinder). Find the electromotive force (voltage) $\mathcal{E}$ between the ends of the wire.

iii) (2 pts) Suppose that the wire connecting the axis of the cylinder with the cylindrical surface is not radial and has an arbitary shape (still, there are no segments protruding outside the cylinder). Show that $\mathcal{E}$ does not depend on the shape of the wire.